REMARKS

This application contains claims 1 through 65, all of which have been allowed.

Applicants amended the specification to correct an incorrect usage of a term and, in the paragraph starting at page 71, line 20, to delete a redundant sentence.

Applicants amended Fig. 83 to correct several erroneous reference numbers.

Since this amendment neither raises new issues nor requires further consideration, entry is respectfully solicited.

Respectfully submitted,

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VERSION MARKED TO SHOW CHANGES MADE

IN THE SPECIFICATION

Please amend the portions of the Specification identified below to read as indicated herein.

Paragraph beginning at page 43, line 7:

In the first example of embodiment the illumination system comprises a collector unit, a diverging mirror and a collecting mirror forming a telescope system as well as field lenses, whereby the raster elements are introduced only onto the ~~diverging~~ collecting mirror. All raster elements are identical and lie on a curved supporting surface.

Paragraph beginning at page 57, line 1:

Figure 69 shows another embodiment for a purely refractive system in a schematically view. Corresponding elements have the same reference numbers as those in figure 66 increased by 300. Therefore, the description to these elements is found in the description to figure ~~65~~66. The aspheric collector lens ~~603~~ 6903 is designed to focus the light rays of the light source 6601 in a plane 6905 which is arranged in front of the plate with the field raster elements 6909 as indicated by with the dashed lines. Nearby this image of the light source a transmissions filter 6937 is arranged. This filter can also be used to select the used wavelength range. In the plane 6905 also a shutter can be arranged. The field raster elements 6909 have a positive optical power to produce the secondary light sources 6907 at the plate with the pupil raster elements 6915.

Paragraph beginning at page 60, line 11:

The field raster elements 7209 are rectangular and have a length X_{FRE} and a width Y_{FRE}. All field raster elements 7209 are arranged on a nearly circular plate with a

diameter D_{FRE}. They are imaged into the image plane 7229 and superimposed on a field ~~7233~~ 7231 with a length X_{field} and a width Y_{field}, wherein the maximum aperture in the image plane 7229 is denoted by NA_{field}. The field size corresponds to the size of the object field of the projection objective, for which the illumination system is adapted to.

Paragraph beginning at page 60, line 18:

The plate with the pupil raster elements 7215 is arranged in a distance of Z_3 from the plate with the ~~pupil~~ field raster elements ~~7215~~7209. The shape of the pupil raster elements 7215 depends on the shape of the secondary light sources 7207. For circular secondary light sources 7207 the pupil raster elements 7215 are circular or hexagonal for a dense packaging of the pupil raster elements 7215. The diameter of the plate with the pupil raster elements 7215 is denoted by D_{PRE}.

Paragraph beginning at page 66, line 5:

Figure 75 shows a schematic view of a embodiment comprising a light source 7501, a collector mirror 7503-, a plate with the field raster elements 7509, a plate with the pupil raster elements 7515, a field lens 7521, ~~a~~ an image plane 7529 and ~~a~~ an exit pupil ~~7535~~7533. The field lens 7521 has one normal-incidence mirror 7523 with positive optical power for pupil imaging and one grazing-incidence mirror 7527 with negative optical power for field shaping. Exemplary for the imaging of all secondary light sources, the imaging of one secondary light source 7507 into the exit pupil 7533 forming a tertiary light source 7535 is shown. The optical axis 7545 of the illumination system is not a straight line but is defined by the connection lines between the single components being intersected by the optical axis 7545 at the centers of the components. Therefore, the illumination system is a non-centered system having an optical axis 7545 being bent at each component to get a beam path free of vignetting. There is no common axis of symmetry for the optical components. Projection objectives for EUV exposure apparatus are typically centered systems with a straight optical axis and with an off-axis object field. The optical axis 7547 of the projection objective is shown as a dashed line. The

distance between the center of the field 7531 and the optical axis 7547 of the projection objective is equal to the field radius R_{field}. The pupil imaging field mirror 7523 and the field-forming field mirror 7527 are designed as on-axis toroidal mirrors, which means that the optical axis 7545 paths through the vertices of the on-axis toroidal mirrors 7523 and 7527.

Paragraph beginning at page 67, line 3:

In another embodiment as shown in figure 76, a telescope objective in the field lens 7621 comprising the field mirror 7623 with positive optical power, the field mirror 7625 with negative optical power and the field mirror 7627 is applied to reduce the track length. Corresponding elements have the same reference numbers as those in figure 75 increased by 100. Therefore, the description to these elements is found in the description to figure 75. The field mirror 7625 and the field mirror 7623 of the telescope objective in figure 74 are formed as an off-axis Cassegrainian configuration. The telescope objective has an object plane at the secondary light sources ~~7601~~ 7607 and an image plane at the exit pupil 7633 of the illumination system. The pupil plane of the telescope objective is arranged at the image plane 7629 of the illumination system. In this configuration, having five normal-incidence reflections at the mirrors 7603, 7609, 7615, 7625 and 7623 and one grazing-incidence reflection at the mirror 7627, all mirrors are arranged below the image plane 7629 of the illumination system. Therefore, there is enough space to install the reticle and the reticle support system.

Paragraph beginning at page 70, line 7:

The field mirror 7725 is a convex mirror. The used area of this mirror defined by the incoming rays is an off-axis segment of a rotational symmetric conic surface. The mirror surface is drawn in figure ~~75~~77 from the vertex up to the used area as dashed line. The distance between the center of the plate with the pupil raster elements 7715 and the center of the used area on the field mirror 7725 is 1400mm. The mean incidence angle of

the rays on the field mirror 7725 is 12°. Therefore the field mirror 7725 is used at normal incidence.

Paragraph beginning at page 70, line 14:

The field mirror 7723 is a concave mirror. The used area of this mirror defined by the incoming rays is an off-axis segment of a rotational symmetric conical surface. The mirror surface is drawn in figure ~~75~~ 77 from the vertex up to the used area as dashed line. The distance between the center of the used area on the field mirror 7725 and the center of the used area on the field mirror 7723 is 600mm. The mean incidence angle of the rays on the field mirror 7723 is 7. 5°. Therefore the field mirror 7723 is used at normal incidence.

Paragraph beginning at page 70, line 21:

The field mirror ~~727~~ 7727 is a convex mirror. The used area of this mirror defined by the incoming rays is an off-axis segment of a rotational symmetric conic surface. The mirror surface is drawn in figure ~~75~~ 77 from the vertex up to the used area as dashed line. The distance between the center of the used area on the field mirror 7723 and the center of the used area on the field mirror 7727 is 600mm. The mean incidence angle of the rays on the field mirror 7727 is 78°. Therefore the field mirror 7727 is used at grazing incidence. The distance between the field mirror 7727 and the image plane 7731 is 300mm.

Paragraph starting at page 71, line 20:

Figure 79 shows the illumination of the exit pupil 7733 for an object point in the center (x=0mm; y=0mm) of the illuminated field in the image plane 7731. The arrangement of the tertiary light sources 7935 corresponds to the arrangement of the pupil raster elements 7715, which is presented in figure 74. Wherein the pupil raster elements in figure 74 are arranged on a distorted grid, the tertiary light sources 7935 are arranged

on a undistorted regular grid. It is obvious in figure 79, that the distortion errors of the imaging of the secondary light sources due to the tilted field mirrors and the field-shaping field mirror are compensated. The shape of the tertiary light sources 7935 is not circular, since the light distribution in the exit pupil 7733 is the result of a simulation with a Laser-Plasma-Source which was not spherical but ellipsoidal. The source ellipsoid was oriented in the direction of the local optical axis. Therefore also the tertiary light sources are not circular, but elliptical.~~ Due to the mixing of the light channels and the user-defined assignment between the field raster elements and the pupil raster elements, the orientation of the tertiary light sources 7935 is different for each tertiary light source 7935.~~

Paragraph beginning at page 76, line 10:

Figure 83 shows another embodiment in a schematic view. Corresponding elements have the same reference numbers as those in figure 82 increased by 100. Therefore, the description to these elements is found in the description to figure 82. In this embodiment the collector mirror 8303 is designed to generate an intermediate image ~~8361~~ 8363 of the light source 8301 in front of the plate with the field raster elements 8309. Nearby this intermediate image 8363 a transmission plate ~~8363~~ 8365 is arranged. The distance between the intermediate image ~~8361~~ 8363 and the transmission plate ~~8363~~ 8365 is so large that the plate ~~8363~~ 8365 will not be destroyed by the high intensity near the intermediate focus. The distance is limited by the maximum diameter of the transmission plate ~~8363~~8365, which is in the order of 200mm. The maximum diameter is determined by the possibility to manufacture a plate being transparent at EUV. The transmission plate ~~8363~~ 8365 can also be used as a spectral purity filter to select the used wavelength range. Instead of the absorptive transmission plate ~~8363~~ 8365 also a reflective grating filter can be used. The plate with the field raster elements 8309 is illuminated with a diverging ray bundle. Since the tilt angles of the field raster elements 8309 are adjusted according to a collecting surface the diverging beam path can be transformed to a nearly parallel one. Additionally, the field raster elements 8309 are tilted to deflect the incoming ray bundles to the corresponding pupil raster elements 8315.

Paragraph beginning at page 77, line 5:

Figure 84 shows an EUV projection exposure apparatus in a detailed view. The illumination system is the same as shown in detail in figure 77. Corresponding elements have the same reference numbers as those in figure 77 increased by 700. Therefore, the description to these elements is found in the description to figure 77. In the image plane 8429 of the illumination system the reticle 8467 is arranged. The reticle 8467 is positioned by a support system 8469. The projection objective 8471 having six mirrors images the reticle 8467 onto the wafer 8473, which is also positioned by a support system 8475. The mirrors of the projection objective 8471 are centered on a common straight optical axis 8447. The arc-shaped object field is arranged off-axis. The direction of the beam path between the reticle 8467 and the first mirror 8477 of the projection objective 8471 is convergent to the optical axis 8447 of the projection objective 8471. The angles of the chief rays ~~8479~~ 8445 with respect to the normal of the reticle 8467 are between 5° and 7°. As shown in figure ~~80~~ 84, the illumination system 8479 is well separated from the projection objective 8471. The illumination and the projection beam path interfere only nearby the reticle 8467. The beam path of the illumination system is folded with reflection angles lower than 25° or higher than 75° in such a way that the components of the illumination system are arranged between the plane 8481 with the reticle 8467 and the plane ~~8383~~ 8483 with the wafer 8473.